

REMARKS

The specification has been amended to correct errors of a typographical and grammatical nature. Due to the number of corrections thereto, applicants submit herewith a Substitute Specification, along with a marked-up copy of the original specification for the Examiner's convenience. The substitute specification includes the changes as shown in the marked-up copy and includes no new matter. Therefore, entry of the Substitute Specification is respectfully requested.

The abstract has also been amended to more clearly describe the features of the present invention.

Entry of the preliminary amendments and examination of the application is respectfully requested.

To the extent necessary, applicant's petition for an extension of time under 37 CFR 1.136. Please charge any shortage in the fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account No. 01-2135 (501.41004X00) and please credit any excess fees to such deposit account.

Respectfully submitted,

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ABSTRACT OF THE DISCLOSURE

In a liquid crystal display device ~~of the present invention~~, a recessed portion is formed in a portion of a periphery of a lower frame, a columnar member is provided to the recessed portion, the columnar member is allowed to pass through a hole formed in a projecting portion which is provided ~~to~~ on an optical sheet, and a side surface of a liquid crystal panel is brought into contact with the columnar member. The columnar member provided ~~to~~ on the lower frame not only determines the position of the liquid crystal panel with respect to the lower frame, but also determines the position of the optical sheet with respect to the lower frame and firmly holds the optical sheet ~~to~~ onto the lower frame, thus preventing the disengagement of the optical sheet from the lower frame.

LIQUID CRYSTAL DISPLAY DEVICE

BACKGROUND OF THE INVENTION

[1. Field of the Invention]

5 The present invention relates to a liquid crystal display device, and, more particularly, to a liquid crystal display device which ^{the invention relates} ~~can enhance~~ ^{is enhanced} the reliability thereof by holding an optical sheet ^{that is} interposed between a liquid crystal panel and a backlight, which is arranged at a back surface of

10 the liquid crystal panel ^{in such a way as to} ~~and the liquid crystal panel~~ ^a at a given position ^{of the optical sheet} ~~and prevent~~ ^{the} positional displacement ^{from each} ~~other~~.

[2. Description of the Related Art]

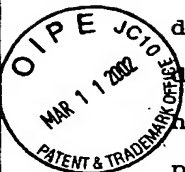
— A liquid crystal display device, which is capable of

15 ^{generating} ~~performing~~ a color display of high definition for a notebook type computer or a computer monitor, is provided with a light source for illuminating ^{the} ~~a~~ liquid crystal panel from a back of the panel (a so-called backlight), and an optical sheet ~~which~~

20 is interposed between the backlight and the liquid crystal panel for correcting ^{the provided} ~~light~~ ^{so that it has} from the backlight ~~to~~ a given brightness distribution with respect to the liquid crystal panel.

— The liquid crystal panel which constitutes this type of liquid crystal display device basically sandwiches a liquid

25 crystal layer between two substrates, at least one of which is ~~formed of~~ a transparent substrate, such as a glass plate or the like. This type of liquid crystal panel is roughly classified



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into a type which turns on and off given pixels by selectively applying voltages to various kinds of electrodes for forming pixels, which are formed on the substrate (simple matrix), and a type which forms the above-mentioned various kinds of electrodes ^{along with} ~~(and)~~ active elements for selecting pixels and turns on and off given pixels by selecting the active elements (active matrix). Currently, ^{due to the} ~~(focusing on a)~~ fact that the active matrix type liquid crystal panel has ^{advantages} characteristics, such as high definition and high-speed display, the active matrix liquid crystal panel has been popularly ^{accepted} ~~(used)~~.

The conventional active matrix type liquid crystal display device ^{employs} ~~(adopts)~~ a so-called vertical electric field type ^{system} in which an electric field is applied between pixel electrodes which are formed on one substrate and a common electrode which is formed on the other substrate so as to change the orientation direction of the liquid crystal layer (see Japanese Laid-open Patent Publication 309921/1988).

On the other hand, ~~(there has been realized)~~ a so-called liquid crystal display device of ^{the} ~~(a)~~ lateral electric field type (also referred to as "IPS type") ^{has been developed in} ~~(makes)~~ the direction of the electric field applied to the liquid crystal layer is substantially parallel to ^{the} ~~(a)~~ surface of the substrate. As ^{an example of a} ~~(the)~~ liquid crystal display device of this lateral electric field type, ^{has been proposed} ~~(there has been proposed)~~ a display device which can obtain an extremely wide viewing angle ^{by} ~~(using)~~ comb-shaped electrodes at one of ^{the} ~~(two)~~ substrates (see Japanese Laid-open Patent Publication 21907/1988, U.S. Patent Specification 4,345,249).

In any one of the above-mentioned liquid crystal display devices, as an illumination light source of the liquid crystal panel, there ^{is} have been known a side edge backlight, which is constituted of a light guide plate and a linear lamp, and a direct
5 backlight, which ^{are directly installed} (directly installs) a plurality of linear light sources at a back surface of the liquid crystal panel.

Particularly, the side edge backlight is constructed as follows. ^A The linear lamp (cold cathode fluorescent lamp, for example) is arranged along at least one side edge of the
10 light guide plate, which is constituted of a transparent plate, such as an acrylic plate. Light irradiated from the linear lamp is introduced into the light guide plate, and ^{the} (a) path of the light is changed in the course of propagation ^{in the} inside of the light guide plate and is irradiated from the light guide
15 plate. Then, the light is corrected to a given brightness distribution by means of an optical sheet, which has a laminated structure ^(formed) (made) of a light diffusion sheet and a prism, and then the light illuminates the liquid crystal panel disposed above the optical sheet.

20 The liquid crystal display device is assembled into a so-called liquid crystal display module by integrating the liquid crystal panel and the backlight together with the optical sheet using an upper frame and a mold case (also referred to as ^a "lower frame"). Usually, the light guide plate
25 which constitutes the backlight is fitted into the mold case which constitutes the lower frame, and, thereafter, the optical sheet is positioned on the mold case. Then, the liquid crystal

panel is mounted on and is positioned on the optical sheet.

However, the optical diffusion sheet and the prism sheet, which constitute the optical sheet, are extremely thin film-like members. These film-like members must be positioned at a given

5 position on the lower frame. Further, it is necessary to prevent ^athe positional displacement and ^{the assembly during the}the disengagement of the film-like members in the course of conveying ^{in a}the manufacturing process or in the course of transporting ^{for further assembly}to an assembly plant.

10 ^{an example of} Fig. 17A and Fig. 17B are schematic ^{diagrammatic illustration}views for explaining a conventional ^{example of a}structure for positioning and holding an optical sheet in a liquid crystal display device, wherein Fig. 17A is a cross-sectional view of ^{a relevant}an essential part and Fig. 17B is a developed perspective view of the ^{relevant}essential part.

15 In Fig. 17A and Fig. 17B, MCA indicates a lower frame ^{in the}which is ^{formed by}formed by a resin mold ^{which}and is configured to house a reflection sheet RFS, a light guide plate GLB, an optical sheet OPS, a liquid crystal panel ^{PNL}and the like. The reflection sheet

20 RFS is mounted on the lower frame MCA, and the light guide plate GLB ^{is}fitted ^{into}into the reflection sheet RFS from above. The optical sheet OPS is positioned on the light guide plate GLB.

In this example, as shown in Fig. 17B, the optical sheet OPS is constituted of four film members in total, wherein

25 optical diffusion sheets SPS are laminated to both sides of two prism sheets PRS whose groove directions cross each other. A projecting portion (lug) TAB is formed on one of ^{the}peripheries

of the optical sheet OPS, and the optical sheet OPS is positioned by ^{passing} allowing a columnar member (pin) PIN, which is mounted on the lower frame MCA ~~to pass~~, through a hole HOL formed in the projecting portion TAB. Thereafter, a cylindrical sleeve SB
5 made of silicone or rubber is fitted on the columnar member PIN from above the columnar member PIN so as to fix the optical sheet, thus preventing ~~(the)~~ removal or ~~(the)~~ disengagement of the optical sheet OPS from the columnar member PIN.

Then, the liquid crystal panel PNL is assembled into
10 the lower frame MCA and ~~(then)~~ ^{then} is covered with an upper frame SHD. Subsequently, the upper frame SHD is fixed to the lower frame MCA so as to form an integrated liquid crystal display module.

The mounting position of the columnar member PIN is
15 usually disposed at one of ^{the} peripheries of the lower frame MCA so as to avoid a side of the liquid crystal panel PNL on which a driver is mounted and a portion thereof where a liquid crystal filling and sealing opening is formed. A similar structure or a structure which simply holds the optical sheet loosely
20 is provided at other peripheries of the lower frame MCA.

Fig. 18A and Fig. 18B are schematic views ~~for explaining~~ ^{illustrating} another conventional example of the positioning of an optical sheet in a liquid crystal display device and a holding structure thereof, wherein Fig. 18A is a cross-sectional view of a
25 ^{relevant} ~~essential~~ part and Fig. 18B is a plan view of the ^{relevant} ~~essential~~ part. ^{the same} Numerals ~~(which are as same)~~ ^{used in} as those ~~(of)~~ Fig. 17A and Fig. 17B indicate identical functional ^{element} ~~portions~~.

In this example, U-shaped walls WL which surround projecting portions TAB formed on an optical sheet OPS from three directions are formed ^{at} ~~(in)~~ four peripheries of a lower frame, and the projecting portions TAB formed on the optical sheet OPS are fitted into and seated in recessed portions formed ~~(in)~~ ^{by} these U-shaped walls WL so as to ^{provide for} ~~(perform)~~ the positioning of the optical sheet OPS.

Further, there may be a method in which such U-shaped walls WL are formed only at ^{two} opposing ~~(two)~~ peripheries or neighboring peripheries, ^{in which} ~~or~~ the U-shaped wall WL is formed at only one periphery and the optical sheet OPS and the lower frame are fixed to each other using an adhesive tape or the like at peripheries which are not provided with the U-shaped walls WL.

Fig. 19 is a developed perspective view ~~(of an essential)~~ ^{illustration} ~~(part for explaining)~~ a further conventional example of ~~the~~ positioning of an optical sheet in a liquid crystal display device and a holding structure thereof. In this conventional example, recessed portions DH are formed in front and back surfaces of a lower frame MCA. Columnar members PIN, similar to the columnar members PIN of the example ^{described} ~~(explained)~~ in conjunction with Fig. 17A and Fig. 17B, are formed such that they ~~(are)~~ project ~~at~~ at both front and back sides of the recessed portions DH. A projecting portion TAB, which is formed on the optical sheet OPS, is seated in the front-side recessed portion DH such that the columnar member PIN ~~(is allowed to)~~ ^{es} pass ~~through~~ a hole HOL formed in the projecting portion TAB. Thereafter, a clip CLM is fitted on the columnar members PIN which are

projected at both front and back sides of the recessed portions DH.

This clip CLM is provided with an opening PR1 into which the front-side columnar member PIN is fitted from the lateral direction and an opening PR2 into which the back-side columnar member PIN is fitted from the lower direction. The clip is formed of a metallic resilient material and resiliently fixes the optical sheet OPS to the lower frame MCA.

10 (As literatures which disclose ^{Examples of} the above-mentioned structures are disclosed) (related art), for example, ⁱⁿ Japanese Laid-open Patent Publication 281966/1999, Japanese Laid-open Patent publication 90361/1997 and Japanese Laid-open Patent Publication 258756/2000 (are named).

15 SUMMARY OF THE INVENTION

The structure for positioning the optical sheet ^{relative} to the lower frame in the above-mentioned conventional liquid crystal display devices ^{the} has (a) following drawbacks to be solved.

20 With respect to the conventional structure which has been explained in conjunction with Fig. 17A and Fig. 17B, the columnar member PIN is required to ^{have a sufficient} ensure the height ^{to} (for making) to allow the sleeve ^{to} fit on the columnar member PIN, so that ^{the} projecting ^{length thereof} (quantity) from the lower frame MCA ^{must be substantial} is increased. When this projecting ^{length} (quantity) is increased, the size of the lower frame

— 25 in the member thickness direction is increased, so that ^{the} (a) special care is required in ^{else} packaging of parts, or (the) chipping may occur at the time of transporting or handling the lower frame MCA

before advancing to ^{the} assembling step. Further, in this constitution, the positioning of the liquid crystal panel PNL is ^{not related} irrelevant to the positioning of the optical sheet OPS.

With respect to the conventional example which has been explained in conjunction with Fig. 18A and Fig. 18B, the optical sheet OPS has the projecting portions TAB thereof simply fitted into the ^{space formed by} U-shaped walls WL from above. Accordingly, at the time of conveying ^{the assembly during} (in) the manufacturing ^{process} (step) or at the time of transporting ^{the assembly} to ^{another} (other) manufacturing section, the above-mentioned projecting portions TAB ^{may disengage} fall from the U-shaped walls WL, or ^{may occur} (the) ^a positional displacement of the optical sheet OPS ^{may occur} arises. Further, also in this constitution, the positioning of the liquid crystal panel PNL is ^{not related} irrelevant to the positioning of the optical sheet OPS.

In the conventional structure shown in Fig. 19, since the metallic clip CLM is used for securing the optical sheet OPS, the possibility that the metallic clip CLM ^{may come} is brought into pressure contact with a liquid crystal panel ^{that is} laminated above the optical sheet OPS and ^{subject} gives an unexpected damage to the liquid crystal panel ^{to damage} can not be ^{ignored} denied. Further, the use of such a metallic clip CLM becomes one of obstacles which hampers the reduction of cost ^{in the manufacture of the liquid crystal display} structures.

Further, none of the above-mentioned ^{structures} related arts suggests the positioning of the liquid crystal panel, which is mounted on the optical sheet, after mounting the optical sheet on the lower frame.

Accordingly, it is an object of the present invention to solve ^{the} various problems ^{above} of the above-mentioned ^{related} arts and to provide a liquid crystal display device which can provide ^{secure} (the) reliable positioning and ^{relative} (the) holding of the optical sheet, to the lower frame ^{by of} (and can) use a positioning guide ^{on the} of a liquid crystal panel and positioning means ^{on} (of) the optical sheet in common, whereby the liquid crystal display device can have a structure ^{which is} capable of suppressing the removal or disengagement of the optical sheet assembled ^{the assembly} (to) the lower frame at the time of transporting ^{it,} or at the time of transferring, so as to reduce man-hours for assembling and simplifying the operation and reducing ^{the} the manufacturing cost.

To achieve the above-mentioned object, in ^{accordance with} the present invention, a recessed portion (an indentation formed in a side wall which constitutes a frame, for example) is formed in a frame member (a lower frame, a mold case, for example) which holds and secures a light guide plate, an optical sheet and a liquid crystal panel; a columnar member is mounted or formed on the recessed portion ^{and the} (an) optical sheet ^{is provided with} (having) a projecting portion in which a through hole is formed ^{so as to} allow the columnar member to pass through the through hole, whereby the optical sheet is positioned and held in the frame member, wherein the columnar member also functions as a guide for determining the position of the liquid crystal display panel with respect to the frame member. ^{To describe the} Typical constitutions of the present invention ^{described} [they] are as follows.

Constitution (1):

The liquid crystal display device includes a liquid crystal panel (also referred to as "a liquid crystal display panel" or "a liquid crystal display element"), a backlight
5 which is mounted on a back surface of the liquid crystal panel through an optical sheet, a rectangular lower frame (a mold case) which houses the backlight therein, and an upper frame (a metal case) which forms a picture frame for exposing an effective display area of the liquid crystal panel, has side
10 walls extending toward the lower-frame side and is fixed to the upper frame^[wherein].

The liquid crystal display device further includes a columnar member at a portion of a periphery of the lower frame which is served for restricting and holding the optical sheet
15 at a given position, as well as for positioning the liquid crystal panel at a given position, and the optical sheet includes a through hole which allows the columnar member to pass therethrough at a side portion thereof, which corresponds to the periphery on which the columnar member is mounted.

20 The back surface of the liquid crystal panel^(means^{is}) one of a pair of main surfaces of the liquid crystal panel which is positioned at a back of the liquid crystal panel (the liquid crystal display device on which the liquid crystal panel is mounted in a strict sense) as viewed^{by} ~~(from)~~ a user. Irrespective
— 25 of the shape, any backlight, including a side edge backlightⁱⁿ which ^{is arranged} ~~(arranges)~~ a light guide plate^{at} a back surface of the liquid crystal panel in an opposed manner and a direct backlightⁱⁿ

which ~~(arranges)~~ a plurality of light sources^{are arranged} at a back surface of the liquid crystal panel in an opposed manner, can be used.

The effective display area ~~(means)~~^{is} an area which is ~~(served)~~^{used} for reproduction of desired images within the main surface of the liquid crystal panel. ~~The~~^A through hole ~~(means)~~^{is} a so-called opening, and ~~(the)~~⁹ through hole can be formed into any suitable shape.

Constitution (2):

The optical sheet shown in the constitution (1) includes at least one light diffusion sheet or at least one prism sheet and is constituted by laminating at least one light diffusion sheet and at least one prism sheet when necessary.

The liquid crystal display device which performs ~~(the)~~ active matrix driving in an In-Plane Switching (hereinafter abbreviated as "IPS") system uses a so-called direct backlightⁱⁿ which ~~(arranges)~~ a plurality of tubular light sources^{are arranged} such that these light sources face the main surface of the liquid crystal panel in an opposed manner, and hence, it is preferable to use a diffusion plate as at least one light diffusion sheet.

Further, the liquid crystal display device mounted on a notebook type computer adopts a so-called side edge backlightⁱⁿ which ~~(makes)~~ a light guide plate formed of acrylic resin or the like face^{in which} a main surface of a liquid crystal panel in an opposed manner and ~~(arranges)~~^{is arranged} at least one tubular light source at a side surface thereof (the tubular light source being prevented from facing at least an effective display area of the main surface of the liquid crystal panel). However, it may be possible to

use a prism sheet which has a prism surface at the light guide plate side as at least the above-mentioned one prism sheet.

Further, it is preferable to use a light guide plate which has a light scattering surface at a prism sheet side thereof.

5 In any case, a projecting portion is formed at a side portion of the optical sheet which corresponds to a periphery of the lower frame on which the columnar member is mounted and a through hole which allows the columnar member to pass therethrough is formed in the projecting portion of the optical
10 sheet.

Constitution (3):

 In the constitution (2), a recessed portion which accommodates the projecting portion of the optical sheet is formed in the periphery of the lower frame where the columnar
15 member is mounted, and the columnar member is allowed to pass through the through hole formed in the projecting portion of the optical sheet so that the optical sheet is fixed to the lower frame.

Constitution (4):

20 In the constitution (1), the columnar member which is mounted on the lower frame is allowed to pass through the through hole formed in the optical sheet, and, with the use of an adhesive tape, the optical sheet is fixed to the periphery of the lower frame where the columnar member is mounted.

25 Constitution (5):

 In the liquid crystal display device defined by the constitutions (1) to (4), another optical sheet holding

structure^{in which} holding^{is held} the optical sheet loosely in comparison with
the aforementioned structure^{which holds} holding^{use of} the optical sheet by the
columnar member and the through hole, is newly provided to one
of peripheries of the lower frame, other than the periphery
5 thereof having the columnar member (also called as "a first
side of the lower frame"). The other periphery of the lower
frame is one of the peripheries thereof^{that is} arranged adjacent to
the aforementioned periphery thereof having the columnar
member (a second side being transverse to the first side), or^{it is}
10 arranged opposite to the aforementioned periphery thereof
having the columnar member (a third side being opposite to the
first side).

Constitution (6):

The optical sheet holding structure in the
15 constitutions (1) to (5) is constituted by a columnar
projection, which is formed on one of the above-mentioned
neighboring peripheries or the above-mentioned opposite
periphery of the lower frame, and an opening which is formed
on other periphery of the optical sheet and allows the columnar
20 projection to loosely pass therethrough.

Constitution (7):

The optical sheet holding structure in the
constitutions (1) to (5) is constituted of a recessed portion,
which is formed in one of the above-mentioned neighboring
25 peripheries or the above-mentioned opposite periphery of the
lower frame, and a projecting portion which is formed on a
portion of the optical sheet corresponding to the recessed

portion and is seated in the recessed portion.

Constitution (8):

5 The optical sheet holding structure in the constitution (7) is provided with a disengagement restriction member which restricts the disengagement of the projecting portion of the optical sheet from the recessed portion.

Constitution (9):

The columnar member in the constitution (1) or (2) is integrally formed with the lower frame (mold case).

10 Constitution (10):

The columnar member in the constitution (1) or (2) is formed separately from the mold case and is fitted into the lower frame (mold case) through a hole formed in the lower frame (mold case).

15 Constitution (11):

The portion of the columnar member in the constitution (9) or (10) for positioning the liquid crystal panel is shaped so that the size thereof in the direction opposite to the liquid crystal panel is different from the size of a portion for holding the optical sheet being formed integrally with or separately from the columnar member.

Due to the above-mentioned respective constitutions, the positioning and the holding of the optical sheet ^{onto} (to) the lower frame (mold case) can be reliably performed, and, at the same time, this function can be also ^{used} [used] as a [function of a] guide for positioning the liquid crystal panel, which is mounted on the optical sheet in a superposed manner, so that the removal

or the disengagement of the optical sheet at the time of conveying or transporting the lower frame into which the optical sheet is incorporated can be suppressed. Further, since the man-hours for assembling can be reduced, the operation is simplified and the manufacturing cost can be reduced.

On the other hand, in the liquid crystal display device described hereinafter, the present invention is embodied in any one of ^{the} [modes of] following constitutions (12) to (24).

10 The liquid crystal display device, ^{described} [illustrated] here includes a liquid crystal panel, a backlight which is arranged to face a first main surface of the liquid crystal panel (a back surface of the liquid crystal panel as viewed ^{by} [from] a user of the liquid crystal display device) in an opposed manner, 15 an optical sheet (see, the above-mentioned constitution (2) with respect to the constitutional content) which is arranged between the first main surface of the liquid crystal panel and the backlight, a first frame (lower frame in the above-mentioned constitution (1)) having a rectangular shape which 20 accommodates the backlight, and a second frame (an upper frame in the above-mentioned constitution (1)) which is formed in ^{the shape of} a picture frame and covers at least a portion of a periphery of a second main surface (a user-side surface of the liquid crystal display device, a so-called front surface of the liquid 25 crystal panel) which faces the first main surface of the liquid crystal panel in an opposed manner and a side surface formed on the first frame.

In the liquid crystal panel, a liquid crystal layer is sandwiched by a pair of substrates (transparent substrates having insulation) and electrodes and wiring patterns which apply an electric field to the liquid crystal layer are formed on a liquid-crystal-layer side main surface of at least one of these substrates.

The backlight includes not only a substantial light source, such as a cold cathode fluorescent lamp or a light emitting element, but also a backlight system, a backlight unit or an illumination device, which is provided with optical elements which are disposed between the light source and the liquid crystal element.

With respect to the direct backlight which arranges a plurality of tubular light sources such that the tubular light sources face the first main surface of the liquid crystal panel in an opposed manner, a reflection plate, which is arranged at a side opposite to the optical sheet (arranged between the tubular light sources and the first main surface of the liquid crystal panel) with respect to the tubular light source, may be included in the backlight. On the other hand, with respect to a side edge backlight, which ^{is arranged} (arranges) a light guide plate (an optical element made of acrylic resin or the like), such that a main surface of the light guide plate faces the first main surface of the liquid crystal panel, at least one tubular light source is arranged to face a side surface of the light guide plate, and a reflection sheet ^{is} is arranged on ^{the} other main surface of the light guide plate, ^{wherein} the light guide plate and

the reflection sheet may be included in the backlight.

A so-called mold case, which is formed by molding synthetic resin, for example, is used as the first frame. In the liquid crystal display device of this example, on one of the main surfaces (including openings formed therein) of the first frame (referred to as "a bottom surface of the first frame" hereinafter), the backlight, the optical sheet and the liquid crystal panel are laminated in this order, and the periphery of the second main surface of the liquid crystal panel is suppressed by a so-called picture frame of the second frame, thus assembling the liquid crystal display device.

As the second frame, a shield case which is produced by forming a window (exposing the effective display area of the liquid crystal panel) in a bottom surface of a metal frame, which is formed in ^{the shape of} a frame using a metal plate, or a metal case which is formed in a box shape, can be used, for example.

To apply the present invention to the liquid crystal display device of the example ^{described} explained above, such a liquid crystal display device exhibits ^{the} following constitutional features.

Constitution (12):

When the periphery of the bottom surface of the first frame is constituted by including a first pair of sides which face each other in an opposed manner and a second pair of sides which extend in the direction intersecting ^{the} a first pair of sides and ^{which} face each other in an opposed manner, at least one first columnar member is mounted on one (first periphery) of a first

pair of sides of the main surface of the first frame which faces the second frame, at least one second columnar member is mounted on one (second periphery) of a second pair of sides of the main surface of the first frame which faces the second frame in an opposed manner, a first opening into which the first columnar member is fitted is formed in a periphery (first periphery) of the optical sheet which faces one of a first pair of sides of the first frame, and a second opening into which the second columnar member is fitted is formed in a periphery (second periphery) of the optical sheet which faces one of a second pair of sides.

Assuming that the first frame has a rectangular bottom surface, the bottom surface of the first frame and the first periphery and the second periphery of the optical sheet are extended in an L-shape from one corner of the bottom surface.

That is, the positional displacement of the optical sheet with respect to the first frame is prevented by two sides of the first frame which are extended in the L-shape.

On the other hand, the positioning of the liquid crystal panel in the first frame becomes necessary in a so-called assembling step of the liquid crystal display device in which the liquid crystal panel is mounted on the optical sheet. Here, when the liquid crystal display device is completed, the liquid crystal panel is constrained by the first frame and the second frame, which covers at least a portion of the side surface of the first frame, and hence, the necessity of such a positioning of the liquid crystal panel becomes decreased. Accordingly,

in the step which places the liquid crystal panel on the optical sheet, it is sufficient to guide two sides of the liquid crystal panel by two sides of the first frame extending in the L-shape.

In this embodiment, the above-mentioned first columnar member is formed into a size which can face the side surface of the liquid crystal panel in an opposed manner, and a portion (portion A) which faces the side surface of the liquid crystal panel in an opposed manner is projected to the side surface side of liquid crystal panel more than ^{the} other portion (portion B) which is fitted into the first opening. For example, when the first columnar member is formed into a circular columnar shape, ^{the} ~~a~~ radius of the portion A is made larger than ^{the} ~~a~~ radius of the portion B. Due to such a constitution, the positioning of the liquid crystal panel in the assembling step of the liquid crystal display device can be performed promptly and reliably.

The shapes of the first columnar member and the second columnar member which have been referred ^{to} in the above-mentioned constitution (12) and ^{which} ~~will~~ be referred ^{to} in the constitutions (13) to (24), respectively ^{and} ~~is~~ not limited to a circular columnar shape. For example, the first columnar member and the second columnar member may be formed ^{to have} ~~in~~ a rectangular parallelepiped shape or a hook shape, ^{they} ~~or~~ may be formed ^{to have} ~~in~~ a wall shape extending along the first periphery or the second periphery.

Constitution (13):

In the above-mentioned constitution (12), "a bank" having a surface which faces a side surface of the backlight is formed on one of a first pair of sides of the main surface

— of the first frame, which faces the second frame in an opposed
— manner (first periphery), and the first columnar member is
formed on this bank.

Due to such a constitution, [since] the position (height
5 measured by using the bottom surface of the first frame as ~~(the)~~^a
reference) of the joining portion between the first columnar
member and the first frame, and such a position of the optical
sheet, can be aligned so that the stress and the distortion which
is applied to the optical sheet at the time of fixing the optical
10 sheet to the first frame at the first columnar member can be
reduced.

Although the bank which is referred^{to} here may be formed
as a wall which surrounds the bottom surface of the first frame,
the bank may be intermittently formed in conformity with
15 openings formed in the bottom surface to ^{enable} perform the heat
radiation from the first frame or to make the first frame^{more}
light-weight~~er~~.

Constitution (14):

In the above-mentioned constitution (13), the periphery
20 of the portion of the bank where the first columnar member is
formed is formed such that the periphery is indented toward
the main surface of the first frame (the bottom surface of the
above-mentioned first frame) which faces the second frame in
an opposed manner.

25 Constitution (15):

In the above-mentioned constitution (12), the second
opening of the optical sheet is formed in the projecting portion

of the optical sheet which ~~(is)~~ project^S_A from the side thereof^A and which faces one of a second pair of sides of the first frame (the second periphery of the optical sheet) toward one of a second pair of sides (the second periphery of the first frame).

5 Constitution (16):

In the above-mentioned constitution (15), on one of a second pair of sides of the main surface of the first frame, which faces the second frame in an opposed manner (second periphery), a projecting portion^{is mounted projecting portion} which is formed closer to the side surface of the liquid crystal panel than the second columnar member ~~[is mounted]~~. This projecting portion is used for positioning the liquid crystal panel with respect to the first frame.

Constitution (17):

15 In the liquid crystal display device of this example, when the periphery of the first frame (the periphery of the bottom surface of the first frame) is constituted by including a first pair of sides which face each other in an opposed manner and a second pair of sides which extend in the direction
20 intersecting a first pair of sides and face each other in an opposed manner, at least one first columnar member is mounted on one (first periphery) of a first pair of sides of the main surface of the first frame, which faces the second frame in an opposed manner, a projecting member which faces a side surface
25 of the liquid crystal panel is mounted on one (second periphery) of a second pair of sides of the main surface of the first frame, which faces the second frame in an opposed manner, a

— fitting member, which is fitted into a periphery of the optical
— sheet, is mounted on the other (third periphery) of a pair of
— the above-mentioned first sides of the main surface of the first
frame, which faces the second frame in an opposed manner.

5 Further, a first opening into which the first columnar
member is fitted is formed in a periphery (first periphery)
of the optical sheet which faces one of a first pair of sides
of the first frame, and a fitting portion into which the fitting
member is fitted is formed in a periphery (third periphery)
10 of the optical sheet which faces the other of a first pair of
sides.

— Further, a portion of the first columnar member, which
— faces the side surface of the liquid crystal panel in an opposed
manner, ^{is} projected ^{more} toward the side surface of the liquid
15 crystal panel, than ^{the} other portion of the first columnar member
which is fitted into the first opening.

Assuming that the first frame has a rectangular bottom
surface, the second periphery has one end thereof joined with
the first periphery and the other end thereof joined with the
20 third periphery. Accordingly, the first periphery, the second
periphery and the third periphery are arranged ^{to have} in a shape ^{of} similar to
^{such} the letter π . In the constitution (17), the liquid crystal
panel is positioned with respect to the first frame using the
— first columnar member and the protruding member, which are
25 arranged in an L shape, while the optical sheet is fixed to
the first frame using the first columnar member and the fitting
— member, which are arranged at two opposing sides ^{in such} of the letter

shape
 π_f

Constitution (18):

In the constitution (17), at least one of fitting members formed in the first frame is formed of the second columnar member, while the fitting portions formed in the optical sheet are formed ^{with} at least one of ^{the} second openings into which the second columnar members are fitted.

Constitution (19):

In the constitution (17), a bank having a surface which faces a side surface of the backlight is formed on the other (third periphery) of a pair of the first sides of the main surface of the first frame, which faces the second frame in an opposed manner, a recessed portion is formed by indenting the bank toward the main surface of the first frame, which faces the second frame in an opposed manner (bottom surface of the above-mentioned first frame), thus forming the fitting member, and a projecting portion which is projected toward the other of a pair of the first sides (third periphery of the first frame) is formed on a side of the optical sheet which faces the other of a pair of the first sides of the first frame (third periphery of the optical sheet), thus forming the fitting portion.

In the third periphery of the first frame, a projecting portion of the optical sheet (projecting along the extending direction of the second periphery) is fitted into a recessed portion formed in a bank of the first frame. Since the optical sheet is formed in a film shape or a planar plate shape having a main surface along the first main surface of the liquid

crystal panel, the optical sheet can be extended or shrunk within the main surface in conformity with the environment in which the liquid crystal display device is used.

When the optical sheet is held by the first periphery
5 and the third periphery of the first frame with similar holding forces, ^{with} due to the expansion of the optical sheet along the extension direction of the second periphery, wrinkles ^{(are) maybe} generated at a portion of the main surface of the optical sheet
— which faces the liquid crystal panel, so that the
10 characteristics of the optical system from the backlight to the liquid crystal panel ^{maybe} (is) damaged.

In the mode of the constitution (19), the holding of the optical sheet at the third periphery of the first frame is made loose compared to the holding of the optical sheet at
15 the first periphery of the first frame. Accordingly, the expansion of the optical sheet along the extension direction of the second periphery of the first frame can be absorbed by the slight displacement of the projecting portion of the optical sheet at the recessed portion of the bank of the first
20 frame.

Constitution (20):

In any one of the modes of the above-mentioned constitutions (12) to (15) and constitution (18), a portion
— of the second columnar member, which faces the side surface of
— 25 the liquid crystal panel (portion A), is projected toward the side surface of the liquid crystal panel ^{more} th than other portion
— of the second columnar member, which is fitted into the second

opening (portion B).

Due to such a portion A of the first columnar member and the second columnar member, the liquid crystal panel can be positioned with respect to the first frame.

5 Constitution (21):

In the liquid crystal display device of this example, when the periphery of the first frame (the periphery of the bottom surface of the above-mentioned first frame) is constituted ^{so as to include} by including a first pair of sides which face each other in an opposed manner and a second pair of sides which extend in the direction intersecting a first pair of sides and ^{which} face each other in an opposed manner, at least one first columnar member is mounted on one (first periphery) of a first pair of sides of the main surface of the first frame, which faces the second frame in an opposed manner, at least one second columnar member is mounted on one (second periphery) of a second pair of sides of the main surface of the first frame which faces the second frame in an opposed manner.

Further, a first opening into which the first columnar member is fitted is formed in the periphery (first periphery) of the optical sheet which faces one of a pair of the first sides of the first frame, while a second opening into which the second columnar member is fitted is formed in the periphery (second periphery) of the optical sheet which faces one of a pair of the second sides of the first frame.

Both of the first columnar member and the second columnar member are configured to have portions (portions A)

which face the side surfaces of the liquid crystal panel in an opposed manner. In the mode of the constitution (21), as in the case of the mode of the constitution (12), the optical sheet is held by the first columnar member and the second columnar member, which are arranged in an L-shape in the first frame, while the positioning of the liquid crystal panel is performed by the first columnar member and second columnar member.

Constitution (22):

10 In the constitution (21), driving circuits of the liquid crystal panel are respectively mounted on peripheries thereof along the other of the first pair of sides (third peripheries) and the other of the second pair of sides (fourth peripheries) of the first frame, while the driving circuits of the liquid
15 crystal panel are not mounted on peripheries thereof along one of the first pair of sides (first peripheries) and the other of the second pair of sides (second peripheries) of the first frame.

In the constitution (22), in the same manner as the
20 constitution (12) and the constitution (20), when the liquid crystal panel is positioned with respect to the first frame using the portions A of the first columnar member and the second columnar member (portions which face the side surfaces of the liquid crystal panel in an opposed manner), the driving circuit
25 parts which are arranged on the side surface of the liquid crystal display panel or flexible printed circuit boards, which supply signals or electric power to the drive circuit parts,

are brought into contact with the columnar member.

Accordingly, there may be a possibility that an error occurs in the positional alignment of the liquid crystal panel due to the thickness of these parts.

5 Accordingly, it is recommended to separate a side surface which is used for positional alignment of the liquid crystal panel and a side surface which is used for supplying signals or electric power (being mounted with a printed circuit board, a connector or the like).

10 When the first frame has a rectangular bottom surface, in the mode of the constitution (22), one end of the first periphery is joined to one end of the second periphery, the other end of the second periphery is joined to one end of the third periphery, the other end of the third periphery is joined
15 to one end of the fourth periphery, and the other end of the fourth periphery is joined to ^{the} other end of the first periphery, whereby the rectangular profile of the bottom surface of the first frame is constituted in the order of the first periphery, the second periphery, the third periphery and the fourth
20 periphery.

Constitution (23):

 In any one of the above-mentioned constitutions (12) to (16), the above-mentioned constitution (18) and the above-mentioned constitutions (20) to (22), the second opening
25 is formed into a shape extending along one of a second pair of sides of the first frame (second periphery) compared to the first opening. For example, while the first opening is formed

into a circular shape, the second opening is formed into an elliptical shape which is elongated along the second periphery (extension direction).

In any one of the above-mentioned constitutions (12) to (16), the above-mentioned constitution (18) and the above-mentioned constitutions (20) to (22), the (forming) position ^{at which} the second opening ^{is formed} in the optical sheet of the liquid crystal display device, which becomes the (presumption) ^{to be spread} basis of these constitutions, is arranged ^{is formed} (away) from the (forming) position ^{at which} ^{is formed} the first opening along the extension direction of the second periphery by a given distance. Accordingly, when the optical sheet (is) expanded ^S in the above-mentioned manner, the given distance is increased.

Based on such a prerequisite, if the first opening of the optical sheet is firmly held by the first columnar member and the second opening of the optical sheet is firmly held by the second columnar member ^{the} to ^{same} degree, the expanded optical sheet is deflected between the first opening and the second opening, so that the optical conditions between the backlight and the liquid crystal panel ^{are changed} (is damaged).

To the contrary, according to one example of the present invention, by elongating the second opening along the second periphery, the conventional deflection of the optical sheet derived from ^a the ^{positional} displacement between the second columnar member and the second opening into which the second columnar member is inserted ^{, such as} caused by (the) expansion of the optical sheet, can be prevented. Accordingly, the optical

problem caused by the deflection of the optical sheet can be
^{eliminated}
A (dissolved).

Constitution (24):

In any one of the above-mentioned constitutions 12 to
5 23, the periphery of the first frame along a pair of the second
sides (the second and fourth peripheries) are more elongated
than the periphery of the first frame along a pair of the first
sides (the first and third peripheries).

The present invention is not limited to the above-
10 mentioned constitutions and, ^{the} constitutions of embodiments
which will be explained later, and various modifications can be
made without departing from the technical concept of the
present invention.

These and other objects, features and advantages of the
15 present invention will become more apparent from the following
description when taken in conjunction with the accompanying
drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

20 Fig. 1 is a developed perspective view of an ^{essential} part of a liquid crystal display device, ^(for) schematically
^{illustrate} explaining a structure for positioning and holding an optical
sheet ^{on} a lower frame and a structure for positioning a liquid
crystal panel ^{in a} (to explain the) first embodiment of a liquid
25 crystal display device according to the present invention;
Fig. 2 is a cross-sectional view of a ^{of a liquid crystal display device} ^{illustrate} ^{essential} part
after constitutional members are assembled to explain the first

embodiment of the liquid crystal display device according to the present invention;

Fig. 3 is a plan view of a lower frame used in the first embodiment of the liquid crystal display device according to the present invention;

Fig. 4 is a developed perspective view ^{illustration} for explaining the overall constitution of the first embodiment of the liquid crystal display device according to the present invention in which a light guide plate, an optical sheet and a liquid crystal panel are mounted on the lower frame shown in Fig. 3, and these members are covered with an upper frame;

Fig. 5 is a plan view ^{illustration} for explaining a structural example of a liquid crystal panel of the liquid crystal display device shown in Fig. 4;

Fig. 6 is a plan view ^d for explaining a first constitutional example of an optical sheet holding structure which loosely holds an optical sheet formed on ^{the} other side (different) from a side to which the positioning function of the optical sheet in the first embodiment of the liquid crystal display device according to the present invention is given;

Fig. 7 is a plan view ^d for explaining a second constitutional example of an optical sheet holding structure which loosely holds an optical sheet formed on ^{the} other side (different) from a side to which the positioning function of the optical sheet in the first embodiment of the liquid crystal display device according to the present invention is given;

Fig. 8 is a plan view ^{of} [for explaining] a third constitutional example of an optical sheet holding structure which loosely holds an optical sheet formed on ^{the} other side (different) from a side to which the positioning function of the optical sheet in the first embodiment of the liquid crystal display device according to the present invention is given;

Fig. 9 is a plan view ^{of} [for explaining] a fourth constitutional example of an optical sheet holding structure which loosely holds an optical sheet formed on ^{the} other side (different) from a side to which the positioning function of the optical sheet in the first embodiment of the liquid crystal display device according to the present invention is given;

Fig. 10 is a plan view of an [essential] part [which shows] of the first constitutional example of the optical sheet holding structure formed on the side close to the fixing side ^{as shown} [explained] in Fig. 6;

Fig. 11 is a plan view of an [essential] part [which shows] of the second constitutional example of the optical sheet holding structure formed on the side close to the fixing side ^{as shown} [explained] in Fig. 6;

Fig. 12 is a perspective view of (an essential part for) [explaining] an example of an optical sheet holding structure at a side close to the fixing side ^{as shown} [explained] in Fig. 6 or at a side which faces the fixing side ^{as shown} [explained] in Fig. 7 in an opposed manner;

Fig. 13 is a cross-sectional view of ^{liquid crystal display device} an [essential] part ⁱⁿ after constitutional members are assembled [to explain] the

second embodiment of the liquid crystal display device according to the present invention;

Fig. 14 is a cross-sectional view of a ^{liquid crystal display device} essential part ^Λ after constitutional members are assembled ⁱⁿ [to explain] the third embodiment of the liquid crystal display device according to the present invention;

Fig. 15 is a developed perspective view [for explaining] ^{showing} an example of ^{the} details of the overall constitution of the liquid crystal display device according to the present invention;

10 Fig. 16 is ^{a perspective} an appearance view [for] showing one example of a notebook type personal computer on which the liquid crystal display device according to the present invention is mounted;

Fig. 17A and Fig. 17B are schematic views [for explaining] ^{showing} a conventional example of positioning of an optical sheet in a liquid crystal display device and a holding structure thereof in an enlarged form, wherein Fig. 17A is a cross-sectional view and Fig. 17B is a developed perspective view;

Fig. 18A and Fig. 18B are schematic views [for explaining] ^{showing} another conventional example of positioning of an optical sheet in a liquid crystal display device and a holding structure thereof in an enlarged form, wherein Fig. 18A is a cross-sectional view and Fig. 18B is a plan view; and

Fig. 19 is a developed perspective view of [an essential] part [for explaining] ^d still another conventional example ^{of} ^{showing} positioning of an optical sheet in a liquid crystal display device and a holding structure thereof.

DETAILED DESCRIPTION

Embodiments of a liquid crystal display device according to the present invention ^{will be described} are explained in detail in conjunction with ^{the} drawings (showing the embodiments).

5 Fig. 1 is a developed perspective view of ~~an~~ [essential] part of a liquid crystal display device for schematically ^{illustrating} explaining a structure for positioning and holding an optical sheet ^{on} a lower frame and a structure for positioning a liquid crystal panel ^{in a} (to explain the) first embodiment of a liquid
10 crystal display device according to the present invention. Further, Fig. 2 is a cross-sectional view ^{showing the arrangement} of an essential part after constitutional members are assembled ⁱⁿ (to explain) the first embodiment of the liquid crystal display device according to the present invention.

15 In Fig. 1 and Fig. 2, reference symbol MCA indicates a lower frame formed by resin molding (also referred to as a mold case, however, this element ^{is referred to} being explained) as ^a "lower frame" hereinafter), DH indicates a recessed portion (indentation) for positioning and holding an optical sheet OPS, and PIN-C indicates a columnar member for performing the
20 positioning by passing through a through hole HOL-C formed in a projecting portion (also referred to as a flap or a tab) TAB which is formed ^{as part of} in the optical sheet OPS. This columnar member PIN-C also functions as a guide for positioning ^{the} a liquid crystal
25 panel PNL.

The shape of the projecting portion TAB is not limited to a rectangular shape ^{as} shown in the drawing and may be a shape

having both projecting side peripheries arranged in a non-parallel form or in a semicircular form or in ^{another} ~~other~~ form. It is preferable to make the shape of the recessed portion formed in the lower frame MCA correspond to the shape of the projecting portion TAB.

The optical sheet OPS of this embodiment is formed of four sheets in total, consisting of two prism sheets PRS and two light diffusion sheets SPS, which are laminated to upper and lower surfaces (front and back surfaces) of these prism sheets PRS. However, the optical sheet OPS is not limited to such a constitution. That is, a combination of one prism sheet and one light diffusion sheet, a combination of two prism sheets and one light diffusion sheet, or a combination of one prism sheet and two light diffusion sheets or other various combinations can be adopted as the optical sheet OPS.

The liquid crystal display device is assembled as follows. First of all, a reflection sheet RFS is mounted on the lower frame MCA, and a light guide plate GLB, which constitutes a backlight, is fitted into the lower frame MCA such that the light guide plate GLB is positioned above the reflection sheet RFS. The light guide plate GLB is positioned ^{so} ~~such~~ that ^{it} ~~the~~ light guide plate GLB is seated in a frame portion for mounting ^{the} ~~a~~ light guide plate, which is formed in the lower frame MCA.

Then, the columnar member PIN-C is allowed to ^{be} passed through the through holes HOL-C which are formed in the respective projecting portions TAB of the respective sheets

which constituted the optical sheet OPS from the direction indicated by (an) arrow A in Fig. 1, and the projecting portion TAB is seated in the recessed portion DH and is fixed by (a) one-sided adhesive tape ATP. By forming a hole through which
5 the columnar member PIN-C passes in the one-sided adhesive tape ATP, the optical sheet OPS can be firmly fixed.

After positioning and fixing the optical sheet OPS, the liquid crystal panel PNL is positioned on the optical sheet OPS using a liquid-crystal-panel-side side wall of the
10 columnar member PIN-C, indicated by a line C-C in Fig. 1 and Fig. 2, as a guide. The holding of ^{the} other sides of the optical sheet OPS and the liquid crystal panel ^{in position} will be explained later.

Fig. 3 is a plan view of a lower frame used in the first embodiment of the liquid crystal display device according to
15 the present invention. The drawing shows a plan view as seen from the liquid crystal panel side. The lower frame MCA of this embodiment has an approximately rectangular shape with a bank portion DAM which has a height at an upper frame side formed on the periphery thereof. A linear lamp (cold cathode
20 fluorescent tube) which constitutes a backlight is arranged at ^{the} (a) lower side of Fig. 3, while a gate driver side and a drain driver side are arranged at ^{the} (a) left side and ^{the} (a) lower side of Fig. 3, respectively.

Respective sides of the lower frame MCA are connected
25 to each other by a plurality of crosspieces BRDG which are arranged ^{so as to take} (taking) the mechanical strength and the heat radiation into account. Engaging recessed portions ALV-R, ALV-L of the

lower frame MCA, which are formed in the bank portion DAM at left and right sides which intersect the lower side on which the linear lamp is arranged, are provided for engagement with the light guide plate (not shown in the drawing) and receive engaging projections SSTP formed on the corresponding sides of the light guide plate.

A liquid crystal filling and sealing opening of the liquid crystal panel is positioned at ^{the} right side of the lower frame MCA and the recessed portion DH, which has been ^{described} explained with ^{reference} respect to Fig. 1 and Fig. 2, is formed in the bank DAM ^{so as to avoid} (avoiding) a portion where the liquid crystal filling and sealing opening is formed. The columnar member PIN-C is provided ^{to} the recessed portion DH.

In this embodiment, an optical sheet holding structure which loosely holds the corresponding side of the optical sheet OPS, and will be explained later in conjunction with Fig. 9 and Fig. 10, is provided ^{on} (to) an upper side (a neighboring periphery of the periphery which has the recessed portion DH) of the lower frame MCA. The columnar member PIN-S is also formed in the optical sheet holding structure provided ^{at} (to) this upper side.

The positional displacement of the optical sheet OPS with respect to the lower frame MCA, having ^{such} a rectangular bottom surface as shown in Fig. 3 (the rectangular bottom surface includes ^{a space} a vacancy) appearing partially at an outline thereof, is prevented by two sides thereof (upper and right sides thereof, as shown in Fig. 3) extended in the L-shape from one corner thereof (an upper-right corner ^{as} shown in Fig. 3).

Fig. 4 is a developed perspective view ~~(for explaining)~~^{showing} the overall constitution of the first embodiment of the liquid crystal display device according to the present invention. As shown in the drawing, a light guide plate, an optical sheet and a liquid crystal panel are mounted on the lower frame shown in Fig. 3, and these members are covered with an upper frame. Fig. 5 is a plan view ~~(for explaining)~~^{showing} only ~~(a)~~^{the} liquid crystal panel ~~shown~~^{of the device} in Fig. 4.

As shown in Fig. 4, the light guide plate GLB, the optical sheet OPS and the liquid crystal panel PNL are assembled to the lower frame MCA; the upper frame SHD made of metal is mounted on the liquid crystal panel PNL; and these members have the peripheries thereof fixed to and ~~(are)~~ integrally formed with the lower frame MCA, thus completing the liquid crystal display device (liquid crystal display module).

That is, by connecting projections PRJN, which are formed on the lower frame MCA, to fixing holes HOLLS formed in the periphery of the upper frame SHD, or by bending paws NL, which are formed on the upper frame SHD, over a back surface of the lower frame MCA, the upper frame SHD and the lower frame MCA are fixed to each other. In Fig. 5, a region ~~(in the)~~ inside of a main surface of the liquid crystal panel PNL, which is indicated by a chained line AR ^{represents} ~~(indicates)~~ an effective display region of the liquid crystal panel.

Engaging projections SSTP are formed on two sides of the light guide plate GLB and are engaged with the engaging recessed portions ALV-R, ALV-L (see Fig. 3 with respect to

ALV-L) formed in the lower frame MCA, so that the light guide plate GLB is housed in the lower frame MCA, while being restricted to a given position.

As shown in Fig. 5, a gate driver IC and a drain driver

IC are respectively directly mounted on two neighboring peripheral sides of the liquid crystal panel PNL (referred to as "FCA system" or "COG" system), and these driver ICs are respectively connected to an interface circuit board FPC3 through flexible printed circuit boards FPC1, FPC2. With

respect to the flexible printed circuit FPC2, GPAD indicates a ground pad, CDC indicates an electronic part, such as a capacitor, chip or the like, and HOLE indicates a position restricting hole.

The flexible printed circuit board FPC2 is folded back to the back surface of the liquid crystal panel PNL, as indicated by an arrow at a portion of a bent window BNTW, and is connected to the interface circuit board FPC3, which is positioned at a back surface of the lower frame MCA, which, in turn, is positioned at a back surface of a laminated body (made) of the liquid crystal panel and the light guide body. Here, although the flexible printed circuit board FPC1 of the gate driver is also bent in the same manner, the flexible printed circuit board FPC1 is fixed to the back surface of the lower-side substrate of the liquid crystal panel PNL.

Fig. 6 to Fig. 9 relate to the optical sheet OPS in the first embodiment of the liquid crystal display device according to the present invention. These drawings are plan views which

illustrate
[explain], various constitutional examples of optical sheet holding structures which loosely hold the optical sheet OPS and are formed on [the] sides other than the side of the lower frame MCA to which the positioning function is given (the side in which the projecting portion TAB-C having a through hole HOL-C is formed).

The above-mentioned positioning function is given to the right side (in the drawing) of the optical sheet OPS, and the optical sheet OPS is fixed to the lower frame after using this positioning function. However, when the optical sheet OPS is fixed in the same manner at other sides, [the] ^a deformation, such as wrinkles or the like, ^{maybe} [are] generated due to [the] ^a change [of an] ^{in the} environment. Accordingly, the holding of the optical sheet OPS at [the] sides other than the side to which the above-mentioned positioning function is given (also referred to as "a fixing side" for [the] convenience sake) is required to be loose.

In the constitution shown in Fig. 6, projecting portions TAB-S are formed on the side (the upper side) adjacent to the above-mentioned fixing side and through holes HOL-S, which are large enough to allow the columnar members PIN-S shown in Fig. 3 to loosely pass therethrough, are formed on the projecting portions TAB-S. Due to such a constitution, the movement of the optical sheet OPS is not obstructed in the above-mentioned neighboring side; and, hence, the deformation of the optical sheet OPS, which may be brought about by [the] environmental changes, can be obviated.

With respect to the optical sheet OPS shown in Fig. 7, projecting portions TAB-R are formed on the side which is arranged opposite to the fixing side and the optical sheet OPS is loosely held by a holding mechanism which will be explained
5 later in conjunction with Fig. 12.

With respect to the optical sheet OPS shown in Fig. 8, through holes HB, which are similar to the through holes HOL-S formed in the projecting portions TAB-S shown in Fig. 6, are formed on the side adjacent to the fixing side, and the optical
10 sheet OPS is held by allowing columnar members similar to those shown in Fig. 6 to loosely pass through these through holes HB.

In Fig. 9, through holes HB, which are similar to the through holes HB shown in Fig. 8, are formed in the side which
15 is arranged opposite to the fixing side of the optical sheet OPS, and the optical sheet OPS is held by allowing columnar members similar to those shown in Fig. 6 to loosely pass through these through holes HB.

Fig. 10 and Fig. 11 are plan views of [the essential] part
20 of the optical sheet OPS. These drawings show the state in which, as ^{described} [explained] in conjunction with Fig. 6, the projecting portion TAB-S is formed on the side (upper side) adjacent to the fixing side and the through hole HOL-S, which is large enough to allow the columnar member PIN-S shown in Fig. 3 to loosely
25 pass therethrough, is formed in the projecting portion TAB-S.

With respect to the through holes HOL-S formed in the

optical sheet OPS, ^{as seen} in Fig. 10, the holes HOL-S ^{are} ~~(is)~~ formed ⁽ⁱⁿ⁾ ~~(in)~~ ^{to have} an elliptical shape, which has ^{the} ~~(a)~~ long axis thereof extending in the direction parallel to the side, and a columnar member PIN-S having a diameter smaller than the short-axis diameter of the through hole HOL-S is mounted on the lower frame MCA side.

Further, ^{as seen} in Fig. 11, a through hole HOL-S ~~(which is formed)~~ in the optical sheet OPS is formed ^{to have} ~~(in)~~ a circular shape, and a columnar member PIN-S having a diameter smaller than a diameter of the circular shape is mounted on the lower frame MCA side.

The shape of through holes HOL-S, which are formed in the optical sheet OPS in Fig. 10 and Fig. 11, and the shape of the columnar members PIN-S, which are formed on the lower frame side and pass through the through holes HOL-S, may be shapes other than the above-mentioned shapes. For example, the through hole HOL-S may be formed in an oblong shape, a polygonal shape, a slit-shape or the like, for example, while the shape of the columnar member PIN-S may have an elliptical cross section, an oblong cross section, a polygonal cross section, a semi-elliptical cross section, or other shape.

Fig. 12 is a perspective view ^{illustration} of an essential part for ~~(explaining)~~ a structural example for loosely holding an optical sheet at a side adjacent to the fixing side ^{, as shown} ~~(explained)~~ in Fig. 6, or at a side which is arranged opposite to the fixing side, ^{as shown} ~~(explained)~~ in Fig. 7.

Although the structure in which the optical sheet is loosely held at the side arranged opposite to the fixing side

is explained as an example here, a structure which loosely holds the optical sheet at the side adjacent to the fixing side will perform the same function..

At one portion or two or more portions on the side which
5 is arranged opposite to the fixing side of the optical sheet OPS, projecting portions TAB-R similar to those ^{described} ~~(explained)~~ in conjunction with Fig. 7 are provided. On the other hand, a pair of ^{projecting} ~~(erecting)~~ walls TS are formed at the lower frame MCA side while forming a gap therebetween which is slightly larger
10 than the width of the projecting portion TAB-R in the direction parallel to the side of the lower frame MCA.

The projecting portion TAB-R of the optical sheet OPS is inserted between a pair of ~~(erecting)~~ walls TS and a press member BKT is fitted on the projecting portion TAB-R in the
15 direction of an arrow so as to constrain the projecting portion TAB-R from above. The projecting portion TAB-R is loosely held in a space defined between a pair of ~~(erecting)~~ walls TS and the press member BKT.

According to the above-mentioned embodiment, the
20 accurate positioning and the holding of the optical sheet OPS ^{in such a way as to} ~~(which can)~~ prevent the removal and the disengagement of the optical sheet OPS from the lower frame MCA, are performed at one side, and, at the same time, it becomes possible to obviate the deformation of the optical sheet OPS which may be caused
25 by ~~(the)~~ environmental changes or the like.

Fig. 13 is a cross-sectional view of ^{the liquid crystal display device} ~~(an essential part)~~ ^{illustrate} after constitutional members are assembled to ~~(explain)~~ the

second embodiment of the liquid crystal display device according to the present invention. In this embodiment, in place of the columnar member PIN-C of the lower frame MCA ^{described} (explained) in conjunction with Fig. 2, a hole NT is formed in the lower frame MCA, an insertion member BT having a pin shape with a head is allowed to pass through a through hole HOL-C formed in the optical sheet OPS and is fitted into the hole NT under pressure so as to position and hold the optical sheet OPS. Although this embodiment is similar to the first ^{described} 10 embodiment, as (explained) in conjunction with Fig. 1, with respect to the holding of other sides of the optical sheet OPS and the other constitutions, the columnar member may be replaced with an insertion member having a pin shape with a head which is similar to the above-mentioned insertion member BT having the 15 pin shape with ^G (the) head which is loosely engaged with the through hole formed in the optical sheet.

In this embodiment, a side wall FF of the head of the insertion member BT at the liquid crystal panel PNL side can be used as a positioning guide for the liquid crystal panel.

20 Accordingly, even when there exists some difference in size with respect to the liquid crystal panel, the insertion member BT can be made to function as a desired positioning guide by changing the size of the head of the insertion member BT.

Further, in this embodiment, by adopting a method in 25 which (the insertion member BT is prepared in the state that the insertion member BT ^{is} passed through the through hole HOL-C formed in the optical sheet OPS, which is integrally formed by

preliminarily laminating a plurality of sheets, and then the insertion member BT is ^{further} pushed into the hole NT of the lower frame MCA, it becomes possible to obtain an advantage that the assembling operation can be simplified.

5 Also according to this embodiment, the accurate positioning and the holding of the optical sheet OPS ^{in such a way as to} ~~(which can)~~ prevent the removal and the disengagement of the optical sheet OPS from the lower frame MCA, are performed at one side, and, at the same time, it becomes possible to obviate the deformation of the optical sheet OPS which may be caused by ~~(the)~~ environmental changes ^{or the like.}

Fig. 14 is a cross-sectional view of ^{a liquid crystal display device} ~~(an essential part)~~ after constitutional members are assembled to ^{illustrate} ~~(explain)~~ the third embodiment of the liquid crystal display device according to the present invention. In this embodiment, a cylindrical sleeve SB, similar to the ^{above-mentioned} cylindrical sleeve SB, which ^(is) ~~was~~ ^{described} ~~(explained)~~ in conjunction with ^(the above-mentioned) Fig. 17A and Fig. 17B, is fitted on the columnar member PIN-C of the lower frame MCA, which ^{was described} ~~(is explained)~~ in conjunction with Fig. 2, thus fixing the optical sheet OPS to the columnar member PIN-C such that the optical sheet OPS is not disengaged from the columnar member PIN-C.

The cylindrical sleeve SB can be made to function as a positioning guide ^{for} ~~(of)~~ the liquid crystal panel PNL by changing the diameter of the cylindrical sleeve SB. Further, by changing the size of the cylindrical sleeve SB or by adjusting ^{the extent of protrusion} ~~(a bulging quantity)~~ of a wall of a side surface ^{thereof} which faces the

liquid crystal panel PNL in an opposed manner, it becomes possible to make the cylindrical sleeve SB function as a desired positioning guide. With respect to the holding of other sides of the optical sheet OPS and other constitutions, this
5 embodiment is similar to the first embodiment, which ^{described} ~~(is)~~ was ~~(explained)~~ in conjunction with Fig. 1, and the above-mentioned second embodiment.

Also, according to this embodiment, the accurate positioning of the optical sheet OPS on the lower frame MCA and the holding of the optical sheet OPS ^{, in such a way as to} ~~(which can)~~ prevent the removal and the disengagement of the optical sheet OPS from
10 the lower frame MCA, are performed at one side of the optical sheet OPS, and, at the same time, it becomes possible to obviate the deformation of the optical sheet OPS which may be caused
15 by ~~(the)~~ environmental changes or the like.

According to the embodiments which have been described heretofore, the positioning and the holding of the optical
sheet ^{into} ~~(to)~~ the lower frame can be reliably performed, and, at the same time, the positioning of the liquid crystal panel which
20 is mounted on the optical sheet in a laminated manner can be performed in common with the above operations so that the removal or the displacement of the optical sheet at the time
of conveying or transporting the lower frame, into which the optical sheet is incorporated, can be suppressed. Further,
25 since the man-hours for assembling can be reduced, the assembling operation can be simplified and the manufacturing cost can be reduced.

Fig. 15 is a developed perspective view, ^{illustration} for explaining an example of ^{the} detail of the overall constitution of the liquid crystal display device according to the present invention.

^{In contrast to} Different from the liquid crystal display panel shown in Fig.

4 and Fig. 5, which constitutes a so-called FCA or COG, ^{construction} in (a) the liquid crystal panel used in this liquid crystal display device (liquid crystal display module), driving circuits (a gate driver, a drain driver) are mounted on a tape carrier package TCP and are connected to input terminal wiring which is pulled

10 out to the periphery of the liquid crystal panel.

^{The liquid crystal display device includes SHD} In Fig. 15, [SHD indicates] an upper frame, made of a metal

plate (also referred to as "metal frame"), [WD indicates] a display window, ^{WD} [INS1 to INS3 indicate] insulation sheets, ^{INS1 to INS3} [PCB1 to PCB3 indicate] printed circuit boards, ^{PCB1 to PCB3} (PCB1: drain-side

15 circuit board (video signal line driving circuit board, PCB2: gate-side circuit board (scanning signal line driving circuit board, PCB3: interface circuit board), [JN1 to JN3 indicate] ^{JN1 to JN3} joiners, which electrically connect the circuit boards PCB1 to PCB3 to each other, [TCP1 and TCP2 indicate] tape carrier packages, ^{TCP1 and TCP2}

20 (TCP), [PNL indicates] a liquid crystal panel, ^{PNL} [GC indicates] a rubber cushion, ^{GC} [ILS indicates] a light shielding spacer, ^{ILS} [PRS indicates] a prism sheet, ^{PRS} [SPS indicates] a diffusion sheet, ^{SPS} [GLB indicates] a light guide plate, ^{GLB} [RFS indicates] a reflection sheet, ^{RFS}

[MCA indicates] a lower frame (a mold frame formed by integral ^{MCA} molding), ^{MO} [MO indicates] an opening of the lower frame MCA, [LP indicates] a fluorescent tube (also referred to as "a tubular light source" or "a linear lamp": usually a cold cathode

fluorescent tube), ^{LP} (LPC indicates) a lamp cable, ^{LPC} (GB indicates) a rubber bushing, ^{GB} which supports the fluorescent lamp LP, (BAT) [indicates] a double-sided adhesive tape, ^{BAT} (BL indicates) a backlight, ^{BL} which is constituted of the fluorescent tube LP, the light guide plate GLB, a lamp reflection sheet LS and the like.

These components are laminated in accordance with the positional relationship shown in the drawing so as to assemble a liquid crystal display device (a liquid crystal display module) MDL.

10 The liquid crystal display module MDL has two kinds of housing/holding members (cases) consisting of the lower frame MCA and the upper frame SHD. The liquid crystal display module MDL is formed by merging the metallic upper frame SHD, which houses and fixes the insulation sheets INS1 to INS3, the printed circuit boards PCB1 to PCB3 and the liquid crystal panel PNL therein, and the lower frame MCA which houses the backlight BL consisting of the fluorescent tube LP, the light guide plate GLB, the prism sheets PRS, the light diffusion sheet SPS and the like.

20 A drain driver IC (an integrated circuit chip), which (is) served ^S (for) ^{to} supply ~~the~~ video signals to respective pixels of the liquid crystal panel PNL, is mounted on the drain-side circuit board PCB1, while a gate driver IC, which (is) served ^S (for) ^{to} scan ~~the~~ pixels, is mounted on the gate-side circuit board PCB2.

25 Further, on the interface circuit board PCB3, an integrated circuit chip, which receives video signals from an external host computer and receives control signals, such as

— timing signals and the like, a timing converter TCON, which
— generates clock signals by processing timing and the like, are
mounted.

5 The clock signals which are generated by the timing
converter TCON are supplied to an integrated circuit chip
mounted on the video signal line driving circuit board PCB1
through clock signal lines CLL mounted on the interface circuit
board PCB3 and the video signal line driving circuit board PCB1.

10 The interface circuit board PCB3 and the video signal
line driving circuit board PCB1 are constituted of multilayered
wiring boards and the clock signal lines CLL are formed as
inner-layer wiring of the interface circuit board PCB3 and the
video signal line driving circuit board PCB1.

15 The drain-side circuit board PCB1 for driving TFTs, the
gate-side circuit board PCB2 and the interface circuit board
PCB3 are connected to the liquid crystal panel PNL through the
tape carrier packages TCP1, TCP2 and these circuit boards are
connected to each other through the joiners JN1 to JN3.

20 Fig. 16 is ^{a perspective} (an appearance) view [for] showing one example
of a notebook type personal computer on which the liquid crystal
display device according to the present invention is mounted.

— The above-mentioned liquid crystal display device is mounted
on a display part of this notebook type personal computer, and
the linear lamp LP is mounted on a lower side of the liquid
25 crystal display device. A body of the notebook type personal
computer includes a key board part and houses a host computer
(a CPU) and other information processing equipment therein.

The liquid crystal display device according to the present invention is not limited to the notebook type personal computer shown in Fig. 7, and it is needless to say that the liquid crystal display device is applicable to a display
5 monitor, a television receiver set and a display device of other equipment in the same manner.

Further, the application of the present invention is not limited to ^a(the) liquid crystal display device using the above-mentioned active matrix type liquid crystal panel. That
10 is, the present invention is also applicable to a display device which adopts a simple matrix type liquid crystal panel or various other kinds of panel-type display devices in the same manner.

As has been described heretofore, the present invention
15 can provide ^a(the) liquid crystal display device which has a structure capable of suppressing the removal or disengagement of the optical sheet assembled to the lower frame at the time of transporting or at the time of transferring ^{the assembly,} so as to reduce man-hours for assembling and simplifying the operation and
20 reducing the manufacturing cost by ensuring the reliable positioning and holding of the optical sheet ^{onto} (to) the lower frame and by using the positioning guide of a liquid crystal panel and positioning means of the optical sheet in common.

While we have shown and described several embodiments
25 in accordance with the present invention, it is understood that the same is not limited thereto, but is susceptible of numerous changes and modifications as known to those skilled in the art,

and we therefore do not wish to be limited to the details shown
and described herein, but intend to cover all such changes and
modifications as are encompassed by the scope of the appended
claims.